**CYTOSCAPE SIMULATION QUESTIONS** Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per:\_\_\_\_\_ Teacher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_Date:\_\_\_\_\_\_\_\_\_\_

**Instructions –** Using any browser except for Internet Explorer, please visit this page to load the Cell Phone Cytoscape Simulator: <http://cellphonesim.systemsbiology.net>.

**Part I - Familiarize yourself with the web application.**

1. First click the “Fit” button. What does this do to the network?

The “Fit” button makes the nodes and edges align in the center of the page.

1. How does your hand drawn network compare to the network displayed on the Cell Phone Cytoscape Simulator? How is it different?

Students should say something about: the student network not having as many edges between nodes, or students will notice that there are multiple edges for every node in both directions. Also, they might note numerous other items about the network. For instance the computer generated network is more organized, 3E is located at the center which makes sense, colors are used to indicate different properties, etc.

1. You and your classmates each created a challenge question about the cell phone network for homework. You should have received another group’s challenge question. Try answering it using this simulator. Feel free to click the buttons at the top of the page to familiarize yourself with the webapp. Or use the “Hints” below to navigate the functions in order to answer your question. If you ever get stuck, look for the “reset your graph” button to start again.

 Write the challenge question you received here:

 Write the answer here:

***HINT:***  *To answer the following questions select the 5C node first, then click the “Statistics” button. Click the “Step” button in the “Phone Tree” to send the message onward. You will be able observe how the message moves through the entire network step by step.*

**Part II**

1. Your teacher just decided to give a pop quiz in biology tomorrow. Student 5C heard her mention this in the hall today after school. Answer the following questions assuming that 5C passes the message on to everyone in his/her phonebook then everyone who hears the message passes it on to everyone in their phone book, etc.
	1. Will the whole class know about the quiz by tomorrow?

 Yes, the whole class will eventually get the message.

* 1. Which person(s) will **receive** the **most** phone calls about the quiz? How many calls does this person receive?

 6D will receive the most calls. It will be 5 phone calls.

* 1. Which person(s) will **make** the **most** phone calls about the quiz? How many calls does this person make?

3E will make the most phone calls.

* 1. Which person(s) will **make** the **fewest** phone calls about the quiz? How many calls does this person make?

 3B makes the fewest phone calls -- zero phone calls.

* 1. If one phone call takes 30 seconds to make, how long will it take for the first message to get from 5C to 2A? (Show your work.)

***HINT:*** *For this series of questions make a prediction. Next select the node and use the “KNOCKOUT” button to run the specific scenario and check your prediction.*

There are 7 Steps, so 7 x 30 sec. = 3.5 minutes

* 1. If student 4D’s phone runs out of batteries and he/she can’t make or receive any calls, how many students will find out about the pop quiz?

29 students will find out about the pop quiz.

* 1. If student 3E is grounded and can’t use his/her phone, how many students will find out about the pop quiz?

10 students will find out about the pop quiz.

**Part III – Using Phone Attributes**

1. Sprint PCS’s cell phone towers are struck down by a meteorite. Will this change who can call who? Are any groups now isolated from each other? (Please give examples such as, “Can group 6 contact group 1?”)

Group 1 can no longer contact group 3. This isolates groups 2, 4, 6, and 7 from the rest. Group 3 does not receive any message at all, and therefore cannot pass it on through 3E to the other groups.

1. Sprint PCS rebuilds its cell phone towers, but one week later AT&T Wireless is bought out and all of its customers temporarily lose their service. Which outage has a bigger impact on our overall cell phone network: Sprint or AT&T Wireless? Explain.

With AT&T knocked out Group 2 becomes isolated, but the rest of the groups are able to stay connected. The impact is greater when Sprint was knocked out, because it affected 4 groups instead of just 1 group.

1. Not all of the phones in our classroom network have analog roam capabilities. If our class goes on a field trip to rural Montana (where only the phones **with** roaming capability will work) will this change who can call who in our network?
	1. List the students that 5C will be able to pass a message to.

5D, 1B, 1C, 1E

* 1. Will students in group 7 be able to pass a message to students in group 2?

 No

* 1. Will students in group 7 be able to pass a message to students in group 5?

No

1. On this field trip, student 3E takes a picture of a cool rock formation and sends it to everyone he/she can (and they, in turn, send it to everyone they can). How many students will receive the picture? (Not all phones can take/send/receive photos.)

 19 students will be able to receive the photo from 3E

1. Student 2D receives a funny email and forwards it to everyone in his/her phone book (and they, in turn, forward it to everyone in their phone books). Which students will receive the email forward? (Notice not all of the phones have email capabilities.)

 Only 4 students will be able to receive the photo from 2D

**Part IV – Summarizing and making connections to scientific and/or biological examples**

1. Please pick 2-3 alpha-bullets below to answer and discuss below:
	1. Given all you are learning about the properties of systems through these lessons, what general patterns have you noticed in this system?
	2. Do you see certain network characteristics as being good (or advantageous) to have in a system? Do some lead to robustness or strength in a system? Do some lead to weakness?
	3. What connections can you make to these patterns, characteristics, and properties? Is there some system you know of in our world that might have some of the same patterns, characteristics, or properties? Please describe.
	4. There are several functions you did not use. Click the “SFN” (Select First Neighbor) button. Give 1-2 real-world scenarios where this function might be useful when analyzing network dynamics.

 We expect answers to vary significantly. We will soon populate this sheet with possible student answers. Stay tuned and if you’d like, please email copies of student answers to see@systemsbiology.org.